

Studies on chevron crickets: *Tryposoma* gen. nov. (Orthoptera, Anostostomatidae), a new genus from Tanzania

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Abstract

A new genus, *Tryposoma* gen. nov., is introduced to accommodate two African anostostomatid species formerly classified under the genus *Libanasa* Walker (*Tryposoma kilomeni* (Hemp & Johns) comb. nov. and *Tryposoma brachyurum* (Karny) comb. nov.). This taxonomic revision includes a key of the species. Detailed discussions on the genital structure of the newly described genus are also provided.

Keywords

anostostomatids, *Libanasa*, megacephalization, phallic complex

Introduction

The African chevron crickets, commonly known as king crickets or wētā (Johns 1997), are a diverse group comprising 75 species distributed among 14 genera, including the subfamilies and tribes Lezininae and Anostostomatinae (Anostostomatini and Anabropsini) (Cigliano et al. 2023). Within the African anostostomatids, several species are characterized by sexual specialization in the mandibles of adult males that display enlarged, arched, or horn-like structures (Gorochoff 2001a). Notably, *Henicus monstrosus* (Herbst, 1803) exhibits the most pronounced variations in male head and jaw morphology, while *Libanasidus impicta* (Stål, 1876) features males with horn-like processes on their mandibles (Gorochoff 2001a, Toms 2001). Additionally, *Spizaphilus* Kirby, 1906 exhibits winged and wingless members, with males possessing remarkably elongated jaws (Griffini 1911, Karny 1937, Johns 1997). Also, male *Nasidius* Stål, 1876 have large, expanded mandibles, while females show no modifications of the mandibles.

Extensive research on Anostostomatidae species in South Africa has been conducted, contrasting with limited knowledge about other regions of the continent (Péringuey 1916, Karny 1929, Toms 2001, Brettschneider et al. 2007). Consequently, the status of many species in these latter regions remains uncertain (Johns 1997,

Cadena-Castañeda and Cortés-Torres 2013). Moreover, the understanding of genera and species across Africa and other parts of the world remains inadequate and perplexing. For instance, *Henicus* Gray, 1837 was previously considered synonymous with the genus *Mimnermus* Stål, 1876 (Johns 1997), despite both containing markedly distinct representatives (Gorochoff 2001a). Therefore, a systematic study of African anostostomatids is imperative to ascertain species status, define genera using additional characteristics beyond traditional criteria, and enhance comprehension in this field.

In this contribution to the knowledge of chevron crickets, we describe a new genus that includes the species *Libanasa brachyura* Karny, 1928, and *L. kilomeni* Hemp & Johns, 2015. We compare this new genus with other chevron cricket genera found in the region. This work builds upon previous studies on anostostomatids led by the first author of this paper (Cadena-Castañeda and Cortés-Torres 2013, Gorochoff and Cadena-Castañeda 2016, Cadena-Castañeda and Monzón-Sierra 2017, Cadena-Castañeda and Weissman 2020, Cadena-Castañeda et al. 2020, 2022a, b, Mendes et al. 2020).

Materials and methods

Material studied.—All available specimens of the two species of *Tryposoma* gen. nov., including the type specimens.

Genital preparations.—Genital dissections followed the methodology outlined in Cadena-Castañeda (2015). The nomenclature for genital structures adheres to Chamorro-Rengifo and Lopes-Andrade's system (2014). External components included the dorsal fold (df), dorsal lobe (dl), lower folds of the ventral lobe (lw.vl), titillatory structure (ti), upper folds of the ventral lobe (up.vl), titillator sclerite (TS), lateral folds of the dorsal lobe (ldl), fore fold of the dorsal lobe (fdl), and sclerotized plate of the dorsal lobe (Sp.dl). Internal components encompassed the ejaculatory duct (ejd), ejaculatory vesicles (ejv), and sclerite of the ventral fold of the dorsal lobe (VS).

Photographic procedure.—Lateral and dorsal view photographs were captured using a Canon RP digital camera, while other morphological characters were documented using an AmScope MU1803 camera attached to a Carl Zeiss Stemi 305 Trino-Stereomicroscope.

Measurements.—Measurements were recorded in millimeters (mm) using the following criteria: *the length of the body* (LB) measured from the frons to the abdominal apex, excluding the ovipositor or wings; *the dorsal length of the pronotum* (Pr), defined as the maximum distance between the anterior and posterior pronotal margins; *the length of the hind femur* (HF), measured from the base to the genicular lobes; *the length of the hind tibia* (HT), from the genicular lobe to the apex; and *the length of the subgenital plate* (SP), corresponding to the distance from its base to its apex.

Depositories.—CAUD: Colección de Artrópodos y otros Invertebrados de la Universidad Distrital Francisco José de Caldas, Bogotá, Colombia. NHMW: Naturhistorisches Museum Wien, Vienna, Austria. CCH: Collection of Claudia Hemp.

Results

Taxonomy

Order Orthoptera Olivier, 1789
Suborder Ensifera Chopard, 1921
Superfamily Stenopelmatoidea Burmeister, 1838
Family Anostomatidae Saussure, 1859
Subfamily Anostomatinae Saussure, 1859

Tryposoma gen. nov.

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Type species.—*Tryposoma brachyurum* (Karny, 1928) **comb. nov.**

Generic diagnosis and comparison.—The new genus described in this study exhibits a morphology that aligns most closely with taxa within the tribe Lutosini. Therefore, we discuss the distinguishing features between *Tryposoma* gen. nov. and these related taxa. However, given its distribution across the African continent, which harbors several wingless genera of anostomatids, we also conducted a comparative analysis with these genera. This approach solidifies the differentiation of *Tryposoma* gen. nov. from other taxa in the same geographic region.

The new genus distinguishes itself from Neotropical Lutosini taxa in several key morphological aspects. Notably, it lacks a plas-tron and features a notably slender tenth tergite, as opposed to the characteristic division of the last tergite into two plates, a common trait found in *Lutosa* Walker, 1869, *Neolutosa* Gorochoy, 2001b and *Rhumosa* Hugel & Desutter-Grandcolas, 2018. Furthermore, certain species of *Lutosa* and *Neolutosa* exhibit spiny projections at the apex of the subgenital plate near the base of the styli, a character absent in *Tryposoma* gen. nov. species. In addition, the paraprocts of the Lutosini are typically slender and narrow, with the epiproct predominantly covering them. In contrast, the species within the new genus possess distinctive paraprocts characterized by a rigid upper section and a ventrally prominent membranous section. The **Sp.dl** of *Tryposoma* gen. nov. is notably narrow, resembling a ribbon, whereas in the Lutosini, it takes the form of a plate shaped like a shoulder blade. Furthermore, the **ti** and **TS** are more pronounced in the new genus when compared to the taxa of Lutosini.

The newly described genus, *Tryposoma* gen. nov., differs from African genera: The females of *Tryposoma* gen. nov. share similarities with those of *Libanasa*, although they are larger in size. In contrast, the males of *Libanasa* and *Henicus* exhibit notable modifications of the mouthparts, distinguishing them from the new genus. *Tryposoma* gen. nov. can be differentiated from other genera exhibiting sexual modification of the head and mouthparts, such as *Borborothis* Brunner von Wattenwyl, 1888 and *Onosandridus* Péringuey, 1916, by the less conspicuous and thick dorsal spines on the hind tibia. Another distinguishing character of the new genus is the absence of a developed horn-like process on the mandibles, which is present in *Libanasidus* Péringuey, 1916. In contrast to genera without sexual modification of the mouthparts and head, such as *Bochus* Péringuey, 1916, *Onosandridus* Péringuey, 1916, and *Onosandrus* Stål, 1876, *Tryposoma* gen. nov. stands out due to its larger body size, reaching approximately 30–40 mm. Most species in the previously mentioned genera are of medium size, typically ranging from 15–25 mm. Furthermore, *Tryposoma* gen. nov. exhibits a conspicuously developed median spur on the hind tibia, extending beyond the first tarsal segment. This is distinct from *Bochus*, *Onosandridus*, and *Onosandrus*, which possess a medium-sized spur similar in size to the dorsal and ventral spurs that does not exceed half of the first tarsal segment. Additional differences between *Tryposoma* gen. nov. and *Bochus* include the absence of a rough rostrum in the former, while the latter possesses a cylindrical and inflexible rostrum. Moreover, the paraprocts of *Tryposoma* gen. nov. are wide, flexible, and flattened, whereas *Bochus* has protruding cylindrical paraprocts extending toward the front of the terminalia.

Included taxa.—*Tryposoma brachyurum* (Karny, 1928) **comb. nov.** (type species) and *Tryposoma kilomeni* (Hemp & Johns, 2015) **comb. nov.**

Etymology.—From Greek – *Trýpes* = hole, and – *soma* = body, *Tryposoma* = hole inhabiting, since all known *Tryposoma* species in East Africa stay in earth holes during the daytime and emerge in the evening and night hours only. The gender of the name is being established as neuter.

Description.—The specimens under study are large in size, measuring between 28 and 40 mm. Coloration in life ranges from yellow to reddish-brown or golden brown, with darker brown pigmentation observed on the posterior margins of the tergites. The hind femora exhibit a bright yellow color that slightly darkens to yellow-brown on the dorsum and apex. Preserved specimens (pinned) display a darker brown coloration (Figs 1, 4, 5). **Head.** The head is dorsally and frontally smooth, with the frontal region being higher than wide. Laterally, it appears widened, and the fastigium is twice as broad as the first antennal segment (Figs 2A, 5A). The eyes are frontally elevated, and the ocelli are conspicuous, with rounded lateral ocelli and an ovoid front ocellus (Figs 2B, 5B). The scapus and pedicellus are unarmed, and the antennae exceed the length of the body. The mandibles and maxilla exhibit symmetry without any sexual specialization (Figs 2A, 5A). The ventral process extends beside the base of the labial segment in front of the base of the lacinia. The palpi are thin, elongated, fully pilose, and dilated at the apex (Figs 2B, 5B). **Thorax.** The pronotum is slightly wider than it is long (Figs 1A, 5B) and does not cover the mesonotum (Fig. 1B). The lateral margin of the pronotum is slightly rounded, and the pronotal disc displays a slight curvature at the anterior and posterior margins (Figs 1B, 5A). The pronotal lateral lobe has a nearly straight dorsal margin with a slight convexity at

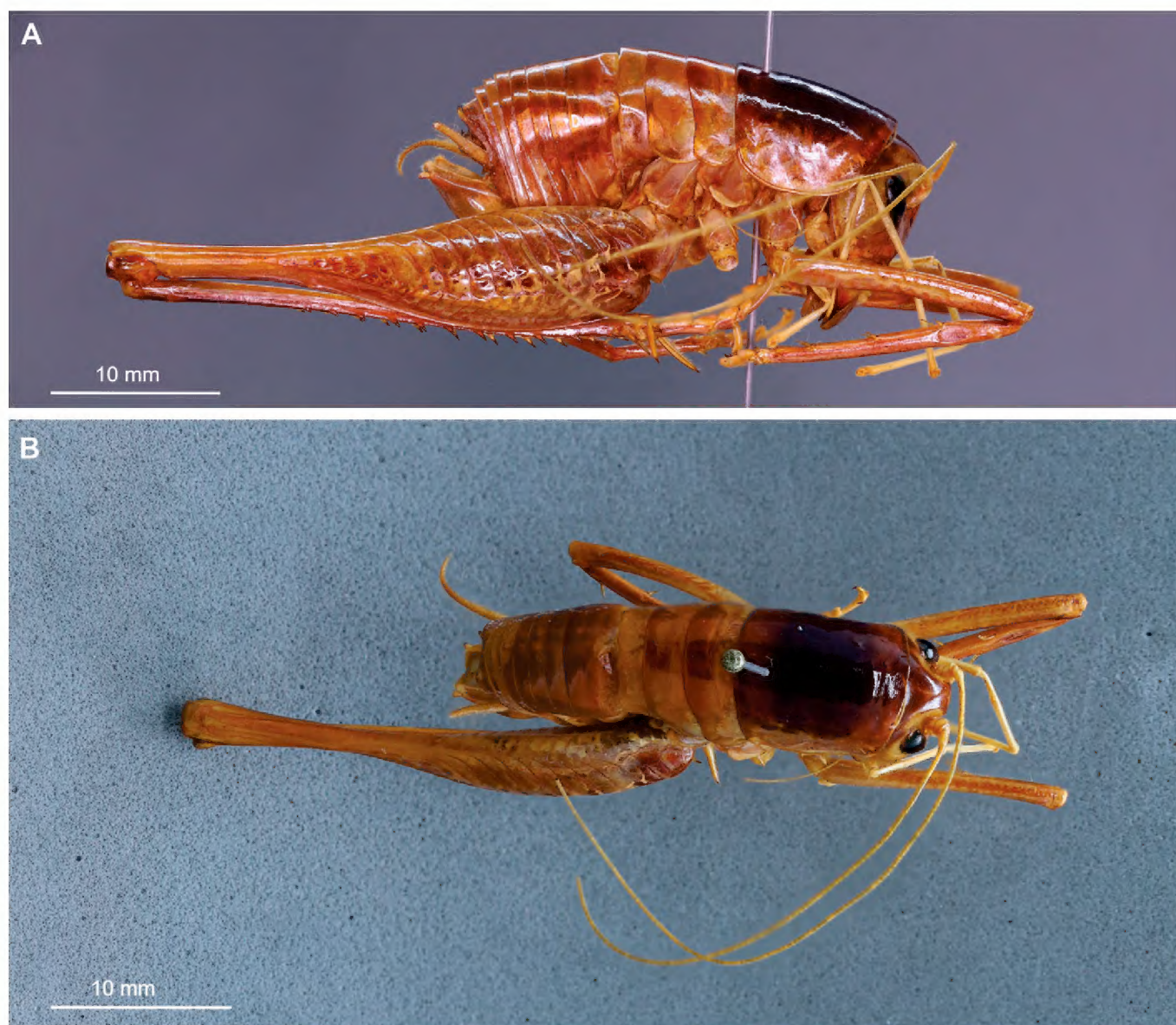


Fig. 1. *Tryposoma brachyurum* comb. nov. male. A. Habitus in lateral and dorsal views, respectively.

the ventral margin. The ventral edge of the mesopleuron forms a weakly projecting rounded flap (Figs 2B, 5B). The prosternum bears a pair of short cone-like processes. The mesosternum is bispinose, with horizontally compressed spines and slightly backward-bent apices. The metasternum features thorn-like processes with acute backward-bent tips and a broad laterally compressed base. Wings are absent. **Legs.** The fore coxae is equipped with one prominent lateral spine having a broad and pointed base. The fore and mid femora display several small tubercles from the base to the apex along with two longitudinal parallel carinae at the ventral margin. The fore and mid tibiae possess spines along the dorso- and ventrolateral margins. A tympanum is present on both sides of the fore tibia. The hind femur exhibits 14–16 distinct chevron ridges well-separated by a medial groove that extends from the base to the distal edge of the chevron area (Figs 1A, 5B). The apical spurs of the hind tibia are fully movable within insertion rings. The dorsal subapical pair is relatively short, the prolateral apical spur is slightly shorter than the metatarsus, and the retrolateral apical spur reaches the midpoint of the second tarsomere. A short ventroapical pair and an even shorter subapical ventral pair are present. **Abdomen.** Male individuals have minute pegs on the first six abdominal tergites that very likely serve as a stridulatory area (Fig. 2B). The sternites broaden distally. Tergite 9 exhibits posterior undulations. Tergite 10 is characterized by two well-sclerotized hooks moderately separated by a narrow, medial, and membranous area dorsally (Figs 2C, 5C). The epiproctus is rounded and has a width equal to its length. The paraprocts lack modifications and are relatively short, with each apex turned dorsal and featuring two very short spinous hooks (Figs 2D, 5C–E). The cerci are setose, thin, and elongated (Figs 2C–E, 5E). The subgenital plate is broad at the base, with the corners close to the tergite. It extends as a rounded bulbous plate with a weakly emarginate posterior notch. The styles are short and divergent, emerging before the apex

of the subgenital plate (Figs 2E, 5C–E). **Male genitalia:** The surface of the dorsal lobe (dl) displays numerous ovoid microstructures (Fig. 3A). The posterior border of the dl projects toward the anterior margin and tapers into a lingual fold in its last section, curving backward and downward (Fig. 3C). The titillatory sclerite (TS) and the titillator (ti) form a peduncular system with medium-sized denticulate structures, which are surrounded ventrally and laterally by the lateral folds of the dorsal lobe (ldl) (Fig. 3A). A thin and ribbon-shaped sclerotized plate (Sp.dl) is present on the dl and forks at the apex (Fig. 3A, C). The upper folds of the ventral lobe (up.vl) have a rounded distal margin while the lower folds of the ventral lobe (lw.vl) are membranous and possess an angled posterior margin (Fig. 3B). The ejaculatory duct (ejd) is wide and lacks sclerotic structures, and the ejaculatory vesicles (ejv) are rounded and of medium size (Fig. 3B). The ventral sclerite (VS) internally covers the TS, and the fore fold of the dorsal lobe (fdl) forms a “U”-shaped fold surrounding the base of the TS (Fig. 3C).

Female individuals have far fewer and sparser pegs on the stridulatory area. They possess an elongated ovipositor that is as long as the hind femur. The ovipositor exhibits a slight upward curve and has a sharp apex (Figs 2F, 5F). The cerci are thin and medium-sized, and the subgenital plate is subtriangular with a wavy or acute apex (Figs 2G, 5G).

Biology.—All recorded species of the genus *Tryposoma* gen. nov. in East Africa are nocturnal, living within closed forest from lowland to montane forests. During the day, they hide in holes dug into the ground (Fig. 6A). At night, they emerge from their shelters and are found on the forest floor among leaf litter or perched on low vegetation (Fig. 6B). It is noteworthy that all *Tryposoma* species and populations in this region are seasonal, with adult individuals being observed during the warm period of the year, typically spanning from December to April, the first wet period of the year.

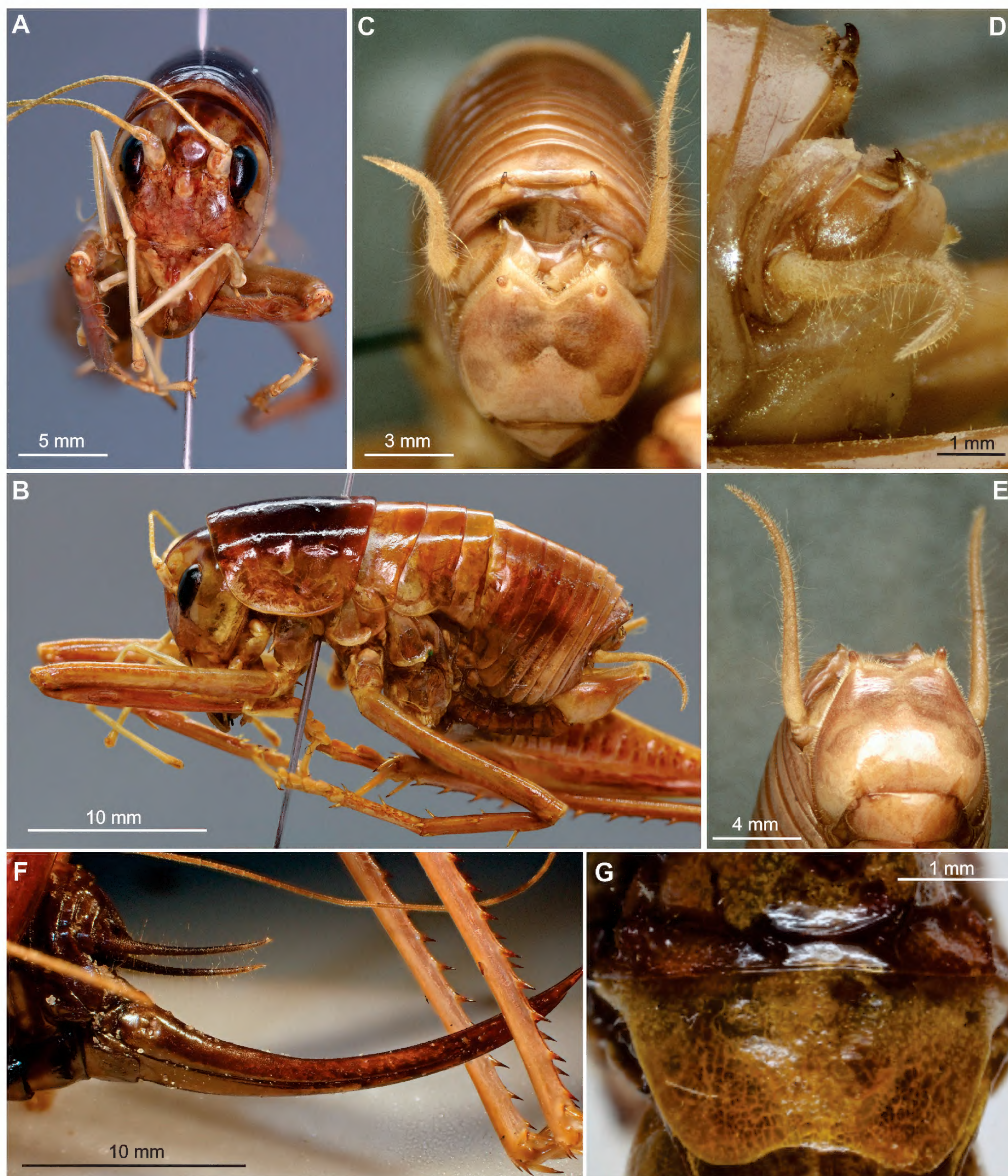


Fig. 2. *Tryposoma brachyurum* comb. nov. A. Face; B. Detail of male body; C–E. Terminalia in axial, lateral (see paraproct detail), and ventral views, respectively; F. Ovipositor in lateral view; G. Subgenital plate of female.

Distribution.—Africa, Northeast Tanzania, restricted to forest of the montane zone of the North Pare Mountains.

Comments.—The type specimen of *T. brachyurum* comb. nov. was initially described based on an immature female specimen (depicted in Fig. 4). By comparing it with additional immature and adult speci-

mens that had been previously examined by Johns and Hemp (2015), as well as specimens subsequently collected by C. Hemp from Tanzania, the accurate identification of these specimens was confirmed.

Specimens examined.—*Tryposoma brachyurum* comb. nov.: Originally described as *Libanasa brachyura* Karny, 1928.

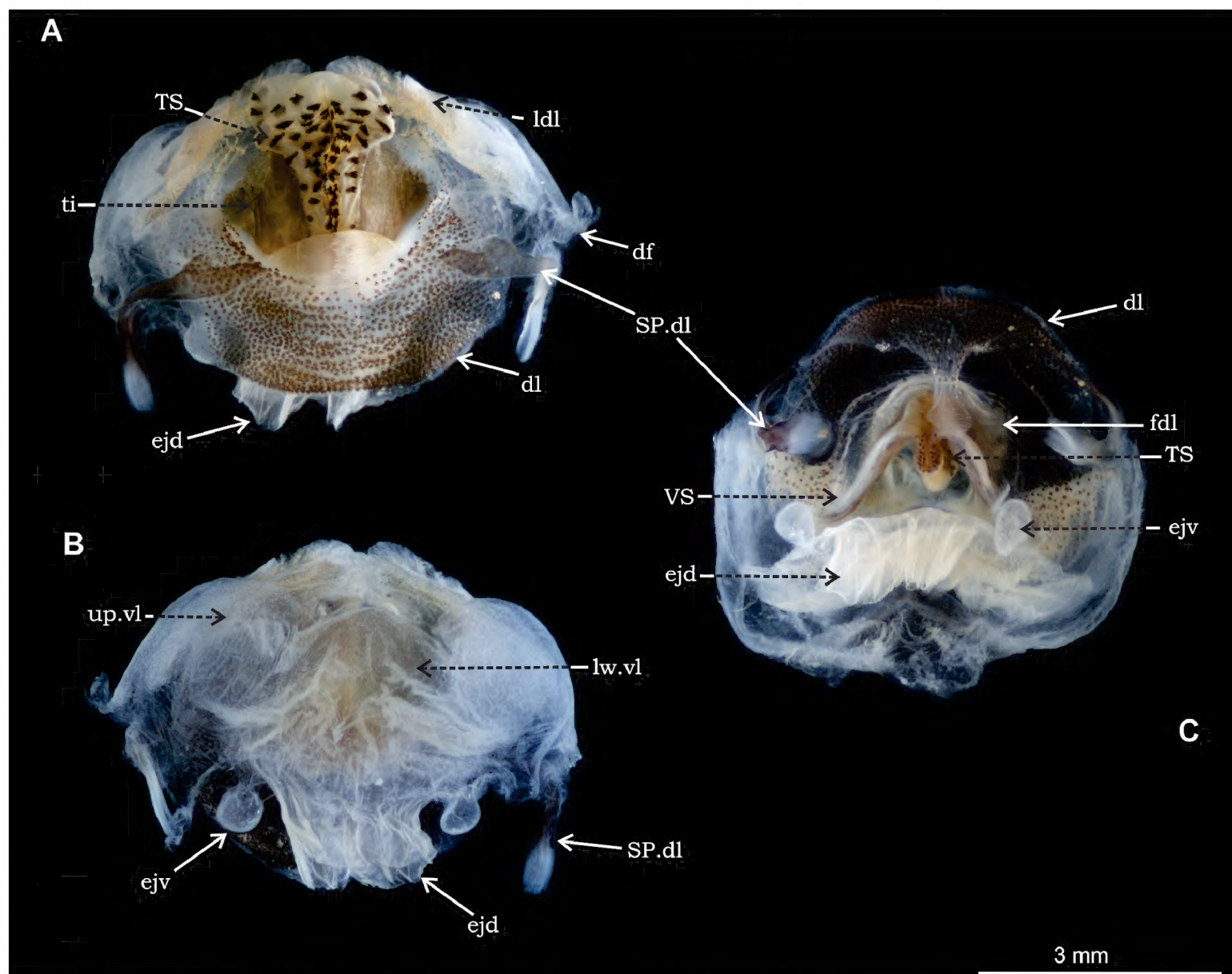


Fig. 3. *Tryposoma brachyurum* comb. nov. A, B. Male genitalia in dorsal, ventral, and axial views, respectively.

Holotype ♀ nymph. labelled (1) *Libanasa brachyura* det Karny Type (in Karny's hand) (2) Coll. Karny (handwritten) (3) Coll. Karny (printed) (NHMW) Dar es Salaam, Tanzania. There is also a so called "allotype" that is a very small female nymph (NHMW). 2 ♂♂, 1 ♀, 1 ♂ nymph, 1 ♀ nymph, Kazimzumbwi Forest Reserve, Kisarawe District, Tanzania 39°3'E, 6°57'S. Coll. FRONTIER Tanzania, Jan–Feb. 1991 (ZMUC). 1 ♂ nymph, 3 ♀♀ nymphs, Kambai Forest Reserve, Muheza District, (Tanga Region), Tanzania. 4°59'S, 38°41'E. coll. FRONTIER Tanzania, Jan–Feb 1991 (ZMUC). 86 ♂♂ and 75 ♀♀ specimens (and 23 nymphs) of *Tryposoma brachyurum* coming from the following localities: East Usambara Mts (Zigi trail, Amani Nature Reserve, Nilo forest reserve, Magoroto Estate), West Usambara Mts (Mazumbai, Ndelemai, and Magamba forest reserves), (CCH).

Tryposoma kilomeni comb. nov.: Originally described as *Libanasa kilomeni* Hemp & Johns, 2015. Holotype ♂. Tanzania, North Pare Mountains, Kindoroko forest reserve, 7°50'44.5"S, 36°53'00.2"E, montane forest, 1750 m, January 2015. Paratypes 4 ♂♂, 9 ♀♀ and 5 nymphs, same locality as holotype.

Key to species *Tryposoma* gen. nov. (adults only)

- 1 Large-sized (35–40 mm) (Fig. 2B). Distal lobes of the male subgenital plates triangular (Fig. 2C), cylindrical styli (Fig. 2E). Female subgenital plate with the distal edge wavy and no medial prolongation (Fig. 2G)..... *T. brachyurum* (Karny, 1928) comb. nov.
- Medium sized (28 mm) (Fig. 5B). Distal lobes of the male subgenital plate rounded (Fig. 5C), styli divergent, progressively thickening from the base to the apex (Fig. 5E). Female subgenital plate with the distal edge wavy and with a small prolongation (Fig. 5G)..... *T. kilomeni* (Hemp & Johns, 2015) comb. nov.

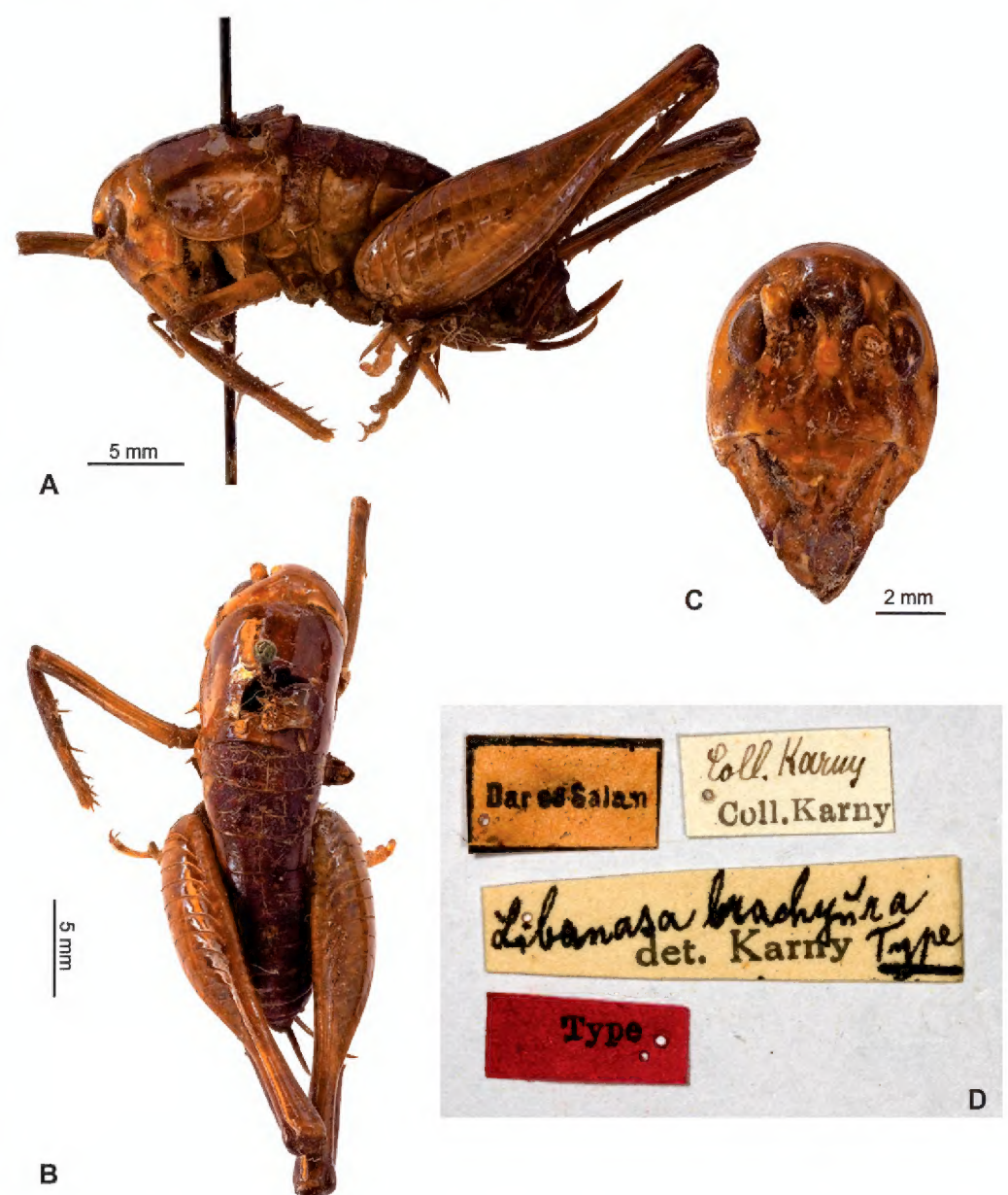


Fig. 4. *Tryposoma brachyurum* comb. nov. Female immature type. A, B. Habitus in lateral and dorsal views. C. Frons. D. Labels. © Natural History Museum Vienna, NOaS Image Collection/H. Bruckner; published with permission.



Fig. 5. *Tryposoma kilomeni* comb. nov. A. Face; B. Detail of male body; C–E. Terminalia in axial, lateral, and ventral views, respectively; F. Ovipositor in lateral view; G. Subgenital plate of female.

Discussion

When comparing the large-sized species found in Tanzania with other species currently classified in the genus *Libanasa*, it becomes evident that they belong to a newly described genus. Well-

documented species with extensive available data, such as *Libanasa signata* (Brunner von Wattenwyl, 1888), *L. capicola* (Péringuey, 1916), and *L. incisa* Walker, 1869, exhibit a medium size, distinct pronotum, short body, and males with hyperdeveloped jaws. The terminalia of these latter species differs from that observed in the

species of the new genus, which comprises larger species without exaggerated development of the jaws. Additionally, the new genus has a morphology of the male genitalia that resembles the Neotropical Lutosini, so it is suggested that it should not be included in any of the current tribes until additional evidence is presented.

The new genus can be distinguished from the Lutosini, including *Lutosa*, *Neolutosa*, and *Rhumosa*, by the division of the tenth tergite into two elongated plates on each side, surrounding the epiproct. This is in contrast to *Tryposoma* **gen. nov.**, which have a narrow tenth tergite (Cadena-Castañeda et al. 2022b). Furthermore, the absence of a plastron, observed in Neotropical Lutosini genera such as *Hydrolutos* Issa & Jaffe, 1999 and *Tintiyakus* Cadena-Castañeda et al. 2020 (Mendes et al. 2020, Cadena-Castañeda et al. 2022b), or the pronounced prolongation of the pronotum over the other thoracic segments, as seen in *Apotetamenus* Brunner von Wattenwyl, 1888 (Cadena-Castañeda and Cortés-Torres 2013, Cadena-Castañeda and Monzón-Sierra 2016), distinguish the Lutosini. These characters exclude *Papuaistus* Griffini, 1911, a genus more closely related to *Aistus* Brunner von Wattenwyl, 1888 and *Carcinopsis* Brunner von Wattenwyl, 1888, limiting the distribution of the Lutosini to the Neotropical region and the Caribbean in line with the grouping proposed by Gorochoff (2001a) comprising the previously described genera.

In this investigation, we meticulously examined the male genitalia of *T. brachyurum* **comb. nov.**, revealing an intriguing and unique organizational pattern characterized by several components that exhibit both internal and external sclerotization. Among the structures within the genitalia that we explored, a particularly striking feature, which we have denoted as **Sp.dl**, came to light. This component could potentially be mistaken for apodeme (AP) sclerites. Notably, this distinctive element, previously unobserved in the genital structure of Tettigoniidea, led us to extrapolate the genital terminology from this family in order to interpret the phallus of the taxa under investigation. As a result, it was not included in the study conducted by Chamorro-Rengifo and Lopes-Andrade (2014). We consider **Sp.dl** to be a novel structural element that has received limited documentation within the Stenopelmatoidea superfamily.

Sp.dl can be distinguished from AP by its nature as an external rather than internal structure. It originates conspicuously from **dl**, contrasting with the flattened broad plate shape observed in the Neotropical Lutosini genera (*Lutosa*, *Neolutosa*, and *Rhumosa*) situated on the sides of **dl**. In contrast, *Tryposoma* **n. gen.** exhibits two slender **Sp.dl** structures positioned sequentially from the back to the front of **dl**. The lateral sclerite of the titillator (**LS**) designation was previously assigned to **Sp.dl** (interpreted by Heleodoro and Mendes 2016). Our observations indicate that **Sp.dl** does not derive from **ti**; instead, it is an autonomous component that likely functions as claspers, aiding in the intrusion and direction of a large spermatophore during copulation. Notably, copulation in this species involves the male providing a substantial nuptial gift to the female (see fig. 7 in Johns and Hemp 2015).

Further investigations focusing on the genitalia of other African taxa belonging to the tribe Anostomatini are necessary to confirm the presence of **Sp.dl** and ascertain whether it may serve as a synapomorphy facilitating the definition and differentiation of these higher-level taxa. Examining the phallus of chevron crickets could prove essential in complementing the current delimitation of taxa, which primarily relies on external morphology.

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Fig. 6. *Tryposoma brachyurum* **comb. nov.** A. Male specimen from Mazumbai forest reserve, West Usambra, Tanzania, sitting in its hole; B. Same specimen emerging at night.

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